Brooklyn, N. Y., May 7, 1919. No. 69.

Published to advance the Science of cold-blooded vertebrates

ABSTRACT OF THE PROCEEDINGS OF THE BROOKLYN MEETING OF THE AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS.

The fourth annual meeting of the American Society of Ichthyologists and Herpetologists was held at the Brooklyn Museum, Brooklyn, N. Y., on Friday, November 15, 1918.

The business meeting was called to order at 9:55 A. M., Mr. Murphy, chairman of the committee of local arrangements, in the chair. Present were Messrs. Engelhardt and Nichols, and by proxy, Mr. Davis and Dr. Gregory. The minutes of the preceding meeting at Cambridge, Mass., were read and approved.

The following officers were elected for the ensuing year: President, Dr. Leonhard Stejneger; Vice-presidents, Professor Bashford Dean, Dr. Barton W. Evermann and Dr. Thomas Barbour; Treasurer, Mr. Henry W. Fowler; Secretary, Mr. John T. Nichols.

Mr. Carl L. Hubbs, of Chicago, was elected a member of the board of governors of the Society.

A motion was carried authorizing the publication of a special number of COPEIA, containing an

abstract of the proceedings of the meeting, providing that the Treasury contained sufficient funds. Mr. R. C. Murphy was appointed to edit and publish the abstract.

By a unanimous vote the director, trustees, and staff of the Brooklyn Museum were tendered the thanks of the Society for their hospitable reception and for many courtesies extended.

The business meeting adjourned at 10:15 A. M.

The public sessions for the reading of papers convened in the Museum auditorium at 10:45 A. M., and continued throughout the day until 6:00 P. M., a luncheon being served for members and their guests at noon in the Museum library. In the absence of the President, and the departure of Vice-president Dean immediately after the presentation of his paper, Mr. Robert Cushman Murphy presided by request.

In a cordial address, Mr. William H. Fox, Director of the Brooklyn Museum, welcomed the members to the Museum and the city, after which the following program was presented.

JOHN T. NICHOLS, *Secretary*.

DR. CHARLES R. EASTMAN'S WORK ON FOSSIL FISHES. Major Bashford Dean, American Museum of Natural History. (No abstract.)

THE PELVIS OF DINOSAURS; A STUDY OF THE RELATIONS BETWEEN MUSCULAR STRESSES AND SKELETAL FORMS. Professor William K. Gregory, American Museum of Natural History. Lantern slides.

The dinosaurs exhibit two fundamentally different types of pelvis, and have consequently been divided by Seeley into the Saurischia, or those with reptilian pelvis, including the gigantic Sauropoda, as well as the more agile Theropoda, and the Ornithis-

chia, or those with bird-like pelvis, including the predentate dinosaurs, such as *Trachodon* and *Triceratops.* The pelvis of the saurischian type is fundamentally similar to that of the Crocodilia, with certain important detailed differences, and consequently a comparative study of the muscles and limb bones of recent reptiles, especially the alligator, affords evidence as to the arrangement of the pelvic muscles in the Saurischia. The wide expanse of the ilium in the Saurischia denotes a corresponding expansion of the deep gluteal muscles and is partly an adaptation for holding one side of the heavy body poised on one limb, while the opposite limb is lifted off the ground. The forwardly directed pubis denotes an arrangement of the muscles for drawing the femur forward and inward, which is fundamentally identical with that seen in the alligator and is of comparatively primitive reptilian type. In consequence of this arrangement the transverse components of the pull of the adductor muscles on the femur were relatively great, a condition that gave great power for the support of the heavy body.

In the Ornithischia, on the other hand, the pelvis has evolved away from the primitive reptilian type toward a very bird-like type, and a comparative study of the muscles and bones of the pelvic region of birds and of reptiles indicates pretty clearly the functional significance of the ornithischian type of pelvis. In these the ischium was greatly extended posteriorly and the pubis was directed backward parallel to the ischium, so that the arrangement of the muscles in this region was doubtless quite bird-like, the muscles of adduction being greatly extended antero-posteriorly. The pectineal process of the birds is represented by a large forwardly directed "prepubic process" which the speaker thought probably bore the extended pubi-ischio-femoralis externus muscle on the outside, and the pubi-ischio-femoralis internus on the inside. Thus all the muscles of adduction were more extended antero-posteriorly than was the case in the

Saurischia and consequently the transverse components of the pull of these muscles were relatively small, while their antero-posterior components were large, an arrangement favorable for rapid progression.

Diagrams were exhibited showing the supposed arrangement of the muscles in these two types of pelvis.

The speaker expressed the hope for increasingly effective co-operation between the students of living reptiles and students of the progressive adaptation and evolution of extinct reptiles.

The paper was discussed by Dr. Uhlenhuth, Professor Gregory, and the Chair.

THE HABITAT OF Gyrinophilus Porphyriticus. Mr. George P. Engelhardt, Brooklyn Museum.

Gyrinophilus porphyriticus, the so-called purple salamander, ranges throughout the whole of the Appalachian system, but is absent from the low country along the Atlantic coast. In the southern part of its range, North Carolina to Georgia and Tennessee, it is represented by *G. danielsi,* a darker race than that of the central and northern sections. Excepting in northwestern Pennsylvania, where it appears to be fairly common, it has been reported only occasionally, and, aside from its preference for cool, secluded localities, not much appears to be known of its development and habitat.

Four adults and one larva of this salamander were collected early in September, 1918, in Panther Brook, a small affluent of Winnisook Creek at its upper reaches in the narrow valley of Big Indian, Ulster Co., Catskill Mts., altitude 2,000 ft.

They were captured singly under submerged rocks in shallow pools near the source of the spring-fed brook. To obtain five specimens required the turning of several hundred stones. None were found under boulders and rotting logs in the surrounding

woods, nor in Winnisook Creek, a larger stream well stocked with trout. The fish greedily devoured specimens of *Eurycea bislineata* and *Desmognathus fuscus* thrown into the water.

When grabbed roughly *Gyrinophilus* resorts to violent contortions and, aided by its slime, is difficult to hold in the hand. None, however, attempted to bite. By gently floating them over flattened hands they could easily be transferred to collecting jars. Their color in life is yellowish or brownish gray, heavily speckled above; immaculate, cream white below. Alcohol changes the color to salmon.

Measurements of the largest adult show a total length of 7 inches; of the smallest, 6 inches. The tail, round at the base, but rapidly flattening towards the tip, is decidedly keeled above. The larval specimen, 2½ inches in length, is gilled; tail flat, broadly finned above and below.

The *Gyrinophilus* station here noted is believed to represent a typical environment for the species. It is above the white pine and oak belt in the Catskill Mountains. Hemlock, sugar maple, ash, birch and beech comprise the principal forest trees. The brook bed traverses several small ravines through a chaos of boulders and stones.

The paper was discussed by Mr. Deckert and Professor Gregory.

On a Collection of Arctic Fishes. Mr. John Treadwell Nichols, American Museum of Natural History.

A portion of Mr. Nichol's paper has been published under the title "Some Marine Fishes from Northwest Greenland" (Bull. Amer. Mus. Nat. Hist., Article XIX, 1918). The remainder, which dealt with an analysis of the marine fishes found near New York, follows.

New York lies in an intermediate latitude and its fish fauna is composed of northern and southern

elements, rather equally mingled; and for that reason if one selects fifty common representative fishes from this locality they will comprise as great a variety of forms as a similar selection from any part of the world. Probably no two persons would agree on exactly the same fifty species, but probably anyone familiar with our local fishes would select a list not very different from the following:

Milbert's shark
Smooth dogfish

Spiny dogfish

Common skate
Big skate
Clear-nosed skate

Herring
Menhaden
Shad
Alewife
Glut herring

Common anchovy
Smelt

Eel

Common killy
Striped killy
Sheepshead minnow

4-spined stickleback

Billfish

Pipefish

Common silverside

Common mullet
White mullet

Striped bass
Sea bass

Porgy

Kingfish
Lafayette
Weakfish

Bluefish

Mackerel

Blackfish
Bergall

Blowfish

Brassy sculpin
Hacklehead
Sea raven

Carolina sea-robin
Striped sea-robin

Toadfish

Eelpout

Silver hake

Cod
Tomcod
Squirrel hake

Fluke
Flatfish
Sundial

American sole

Angler

It will be seen that this list comprises representatives of twenty-eight (28) families, that is, there are 56% as many families as species. A locality in the Arctic would show nothing like the variety, for although Arctic fishes are very abundant in individuals, they belong to very few types. Were the list from an intermediate northern locality, it would lack many of the southern families, and therefore show less variety. Of the 28 families, for instance, I would consider the toadfish, sea-robins, blowfish, bergall, mackerel, bluefish, weakfish, porgy, sea bass, mullet, silverside, pipefish, billfish, killys, anchovy, herrings and Milbert shark families, that is, 17, or a little less than ⅔ of the total, to be southern; the angler, cod, silver hake, eelpout, sculpin, stickleback, spiny dogfish families, that is, ¼ of the total, to be northern. As a matter of fact, New York is sufficiently far north to have in its fauna all the northern elements, the smelt, sculpin, eelpout and cod families being the ones most characteristic of the Arctic; and it is sufficiently far south to have most southern elements represented, even the wrass family, characteristic of tropical coral reefs, being represented by its most northern species (bergall). A more southern locality would lose northern types, and though many southern types would come in to take their place, there would be a dominance of species belonging to certain of the characteristically southern families, and the fifty commonest species would be less scattered and varied.

A broader grouping based partially on relationship and partially on ecological status, that is, similar adaptation of more or less unrelated fishes, leads me to divide our local list into 19 major groups, as follows:

Sharks, skates, herrings (including anchovies), smelt, eel, killys, stickleback, billfish, pipefish, silverside and mullets, bass to bluefish, mackerel, blackfish to blowfish, sculpins and sea-robins, toadfish, eelpout, cods, etc., flatfishes and angler.

Here the division is one of personal judgment, and though I would not expect other ichthyologists

to agree entirely, I think they would, in the main. Of these 19 divisions, flatfishes, cods, eelpout, sculpins, stickleback, and smelt are northern (that is, 6), and the remainder southern in affinities, with the exception of the eel, a catadromous fish, and the angler, whose affinities are deep sea.

An interesting corollary observation is to note the division of the sculpin group, of generally northern affinities into northern and southern divisions, our two families being one northern and the other southern, both represented by common species locally. And to compare this with the flatfish (most developed northward) group, where there is a deep-sea family, the soles, and a shore family, the flounders, the shore family having northern and southern species. It so happens that our sole is a southern shore representative of the deep-sea group, and of the three common flounders, the fluke is southern, flatfish northern, and sundial temperate. It may also be mentioned that the large blenny family has split into northern and southern forms, and is not represented in local waters by any common fish on account of the intermediate position of same.

The paper was discussed by the Chair.

An Adirondack Perch-pike Problem. Mr. Charles W. Mead, American Museum of Natural History.

The speaker had fished practically every day during the month of August, in the years 1915-18, in Stony Creek Ponds, Coreys, Franklin County, N. Y. For the first three years of this period yellow perch were abundant, and pike were so scarce that but three or four would be caught during the month. In August, 1918, however, pike proved abundant, and perch so rare that it was difficult, and sometimes impossible, to obtain one for bait. What caused this reversal in the proportions of the fish population?

Whence came the great numbers of pike, and what has become of the perch?

The paper was discussed by Dr. Ballou, Messrs. Titcomb, Nichols, Engelhardt, and the Chair.

FISH CONSERVATION IN NEW YORK STATE. Mr. John W. Titcomb, N. Y. State Conservation Commission.

Mr. Titcomb, after praising the work of his predecessor, Dr. Bean, explained that the Conservation Commission divided its work in the science of fishes into three divisions, one devoted to protection, another to licensing fisheries, and a third, of which he is head, to propagation. His work relates to the operation of hatcheries and everything relevant to making the waters of the State more productive. He referred to the permanent policy which the Commission is adopting as to the selection of species to stock certain waters, having in mind the investigations which have been and are being made pertaining to the relation of species of fishes to one another, the object being to save waste in the disposition of the hatcheries. Practically all waters can be improved by stocking. All waters have their limitations as to the yield of fish in pounds. The introduction of a species new to a body of water may improve the fishing, but not necessarily so. Nature's balance may be upset entirely. The newly introduced species may afford indifferent fishing, and the total yield of fish of all kinds may be less than before the stocking took place.

One of the most important and constructive efforts of the Commission at the present time is the utilization of abandoned portions of the old Erie and Champlain Canals for the propagation of warm water fishes.

The paper was discussed by Dr. Ballou and the Chair.

Observations on the Distribution of the Blind Texan Cave Salamander, *Typhlomolge rathbuni*. Dr. E. Uhlenhuth, Rockefeller Institute for Medical Research. Lantern slides.

In order to collect a larger number of the blind salamander, *Typhlomolge rathbuni*, two months (August and September, 1916) were spent in San Marcos, Texas. On this occasion several observations regarding the distribution of this animal were made.

In addition to specimens taken from the artesian well of the U. S. Fish Hatchery in San Marcos, *Typhlomolge* were collected in Ezell's Cave, Beaver Cave and Frank Johnson's Well. These three localities contain the water of the subterranean Purgatory Creek system.

At present then it is certain that *Typhlomolge* inhabits the lower Purgatory Creek system and also a system which supplies the San Marcos artesian well and is part of the large sweet water horizon. So far as known, the other artesian wells supplied by the sweet water system and the fissure springs coming from this system do not contain *Typhlomolge*. This is due probably to the possibility that the original habitat of *Typhlomolge* is the Purgatory Creek system, and that the artesian well system communicates with the Purgatory Creek system by means of subterranean channels more than 200 feet in depth, while the other parts of the sweet water horizon do not receive any water from the Purgatory Creek.

From the conditions found in the habitat of *Typhlomolge* it is evident that this salamander prefers water which is under high pressure. Observation of several specimens of *Typhlomolge* in its natural home shows that the animals are walkers and climbers, that their senses are very dull, as demonstrated by the apparently complete absence of light perception and the very weak perception of water waves. Observation of the animal under natural as well as

laboratory conditions, reveals the presence of a number of habits so far found only in the larvae of the red salamander, *Eurycea rubra.* Since the animal does not possess thyroids, according to the finding of E. T. Emmerson, it is almost certain that it cannot metamorphose into a land salamander. The suggestion made by Emmerson, that *Typhlomolge* possibly is the larva of an unknown species of *Eurycea,* meets with difficulty, since, with the exception of *Plethodon glutinosus,* no other salamander inhabits the caves in which *Typhlomolge* is found.

Discussion followed by the Chair and Mr. Deckert.

FIELD OBSERVATIONS ON Ambystoma Tigrinum IN SOUTHWESTERN UTAH. Mr. George P. Engelhardt, Brooklyn Museum. Lantern slides. No abstract. Discussion by Dr. Uhlenhuth and the Chair.

A PROPOSED REDUCTION PLANT FOR THE UTILIZATION OF FISH PRODUCTS. Captain A. D. Doty, New York City.

By invitation, Captain A. Duane Doty, late Infantry, U.S.N.A., A.E.F., briefly addressed the Society, describing a new enterprise of which he is the originator.

Recognizing the great need and opportunity for co-operating efficiently with the Government in increasing the supply of food, and especially of fish, as the best substitute for meat, Captain Doty and several New York gentlemen have organized The St. Andrew's Bay Company to do a general fish business at St. Andrew, Florida.

The company has the active interest and co-operation of the officials of The Bureau of Fisheries and The Food Administration, who have long been anxious to see the fisheries of the Gulf District developed and modernized.

The plans call for the erection of a new, compact, sanitary factory, completely equipped with every form of modern time and labor saving machinery.

The plant will comprise: 1. The Food Division, devoted to sharp freezing, curing and canning the fine fish for which the southern waters are noted. 2. The Reduction Division, utilizing all non-food fish, scrap and waste in the production of fish meal, oil, glue, glycerine, fertilizer material and other by-products. 3. The Tanning Division, manufacturing leather from the skins of shark, ray and porpoise. 4. The Fleet Division, equipped for catching all varieties of fish, including turtle, shark and porpoise.

The company will be the first to combine all departments of the fish business in one co-ordinated plant, organized under the "no-waste," efficiency principles so successfully applied in the meat packing industry.

The company will also be the first to catch and completely utilize all varieties of sharks on a commercial scale, deriving from them leather, food, oil, glue, glycerine, fish meal and fertilizer material.

The executive office will be in New York City.

EGG-LAYING HABITS OF THE PILOT SNAKE, *Callopeltis obsoletus*. Mr. Oliver P. Medsger, Arlington, N. J. Illustrated by photographs.

At Jacob's Creek, Pa., during July, 1913, Mr. Medsger came upon a pair of pilot snakes whose actions seemed out of the ordinary. They had the habit of lying on the surface or burying themselves in an old sawdust pile. When carried away, they would return to the spot. After observing them for three weeks, Mr. Medsger secured a fork, and at a depth of twelve inches dug up 44 eggs of the pilot snake. The male snake was coiled about the eggs. The sawdust, which was about five years old, was cold and wet. The snakes after lying in the hot sun, had the habit of crawling down to the eggs and coiling about

them. As sawdust is a non-conductor, and, at that depth, never would get warm, Mr. Medsger advanced the theory that these snakes by lying in the hot sun until they were warm and then going down to the eggs, were transferring heat from the surface to the eggs and the surrounding sawdust, causing development to go on more rapidly.

Two years later, (July, 1915), this or another pair of pilot snakes, on the same sawdust pile were going through like habits. At that time, Mr. Medsger dug out 24 eggs. On August 1st these eggs were just starting to develop.

A number of photographs of the snakes and eggs were exhibited.

The paper was discussed by Doctors Ballou, Uhlenhuth, Messrs. Titcomb, Engelhardt, and the the Chair.

Notes on the First Turtle I Ever Saw. Mr. Oliver P. Medsger, Arlington, N. J. Illustrated by photographs.

In 1878, the speaker's brothers cut their initials and the date on the plastron of a land tortoise found on the family farm near Pittsburg, Pa. Eighteen years later Mr. Medsger found this same tortoise not more than a hundred yards from the original station. Again, in July, 1913, thirty-five years after he had first seen the animal, he found it within one hundred and fifty yards of the original spot. It looked neither larger nor older than when he had beheld it as a boy.

The Reptiles of Borneo. Mr. H. C. Raven, United States National Museum. (No abstract.) Discussion by Dr. Uhlenhuth and the Chair.

Congo Crocodiles, Lizards and Turtles. Mr. Herbert Lang, American Museum of Natural History.

Mr. Lang, leader of the American Museum Congo Expedition, read his "Ecological Notes on

Congo Crocodiles," written for the report on turtles, crocodiles and lizards by Mr. Karl P. Schmidt, which is now in course of publication.

In company with Mr. James P. Chapin, the party traveled for six years in the Belgian Congo and had ample opportunity for observations. The discovery in the interior of the Congo Basin of a new genus of crocodile, *Osteoblepharon osborni*, called for a comparison of the habits and distribution of the other three species occurring in Africa: *Crocodilus niloticus, C. cataphractus* and *Osteolaemus tetraspis*. It was shown that the Nile crocodile is probably an immigrant in the Congo Basin and the only crocodile occurring outside of the West African Forest Province, and that the other forms are evidently adapted to moist West African conditions. It seems surprising that crocodiles are comparatively rare in the Congo Basin, one of the best-watered tropical regions in the world, with wide and tranquil stretches that make it apparently the most ideal for them, especially as rapids and swifter currents are confined to short sections. Perhaps the scarcity of food and the intermittent character of many of the affluents in this region may be mentioned as important factors in an explanation. An interesting account of native beliefs and methods of trapping crocodiles was followed by the statement that in all the six years' field work not one authentic case of loss of human life due to crocodiles was heard of, although the expedition employed thousands of porters and was in constant relation with many native tribes.

Ichthyological Notes of an Autumn Fishing Trip from the Port of New York. Mr. Robert Cushman Murphy, Brooklyn Museum. (Published in part below, under the title "Notes on a Mackerel Shark from New York.")

In the absence of the contributors the following eight papers were read by title:

NOTES ON THE EGGS AND LARVAE OF SOME SOUTHERN AND WESTERN NORTH AMERICAN SALIENTIA. Professor Albert Hazen Wright, Cornell University.

SOME HABITS OF THE PIGMY HORNED LIZARD. Mr. Herbert J. Pack, Salt Lake City, Utah. (Published in COPEIA, No. 63, pp. 91, 92, 1918.)

THE FISHES OF PERRY COUNTY, PENNSYLVANIA. Mr. Henry W. Fowler, Philadelphia Academy of Natural Sciences. (Published in COPEIA, No. 63, pp. 89-91, 1918.)

A SNAKE ITEM. Mr. C. S. Brimley, North Carolina State Museum. (Published in COPEIA, No. 64, p. 97, 1918.)

THE FRESH-WATER LAMPREYS OF THE EASTERN UNITED STATES. Dr. David Starr Jordan, Stanford University. (Published in COPEIA, No. 64, pp. 93-96, 1918.)

A NEW RECORD FOR Rana Septentrionalis BAIRD. Mr. Philip H. Pope, Manchester, Me. (Published in COPEIA, No. 64, pp. 96, 97, 1918.)

INDUSTRIAL UTILIZATION OF SHARKS, WITH AN EXHIBITION OF SHARK-SKIN LEATHERS. Mr. Alfred Ehrenreich, New York City.

NOTES ON A MACKEREL SHARK, *Isurus Tigris* (ATWOOD), FROM NEW YORK.

ROBERT CUSHMAN MURPHY, Brooklyn Museum.

Plate 1.

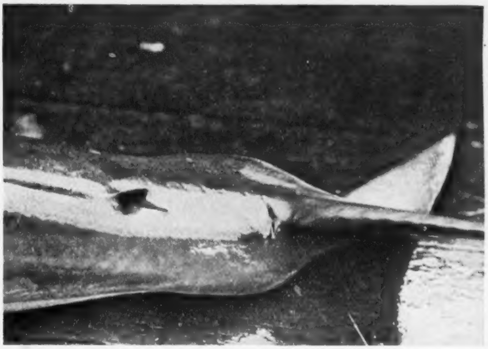
Isurus dekayi Jordan and Evermann, 1896, Bull. 47, U. S. Nat. Mus., p. 48; 1900, idem., Atlas, pl. VI, fig. 21. Nichols and Murphy, 1916, Brooklyn Mus. Sci. Bull. III, No. 1, p. 22, fig. p. 23.

Isurus tigris Garman, 1913, Mem. Mus. Comp. Zool., XXXVI, p. 36. Radcliffe, 1914, Bull. Bur. Fisheries, XXXIV, p. 247 (issued April, 1916).

A less than half-grown female of this relatively little-known shark was caught on a bluefish line near the Ambrose Lightship, off New York Bay, on September 11, 1918, and was examined on the spot by the writer. The species is apparently familiar to New York fishermen under the name "blue shark," for members of the crew of a bluefish schooner pointed out its lunate tail and other features in which it differs from the commoner ground sharks (*Carcharhinus*). The stomach of the specimen contained a quantity of the remains of large bluefish (*Pomatomus saltatrix*). Before the capture of the shark, several bluefish of five or six pounds weight had been bitten in half after being hooked by the fisherman.

Garman has published a practical description of *Isurus tigris,* without an accompanying figure. He states that this shark attains a length of more than ten feet, and that its range extends from the Gulf of Mexico and the West Indies to New York. The figure published by Jordan and Evermann is slightly incorrect in proportions and more so in the form of the snout and of the pectoral, dorsal, and caudal fins. Radcliffe reports that the species has not been taken, at least of late years, on the North Carolina coast, and Nichols and Murphy in 1916 knew of no recent Long Island records. Photographs and figures of the teeth and denticles, of *Isurus tigris* have apparently not heretofore been published, although Garman's work contains both superficial and anatomical drawings of the related porbeagle (*Isurus punctatus*), which is assigned to a different subgenus.

1.



2.

3.

Fig. 1. *Isurus tigris*, ♀. The photograph shows the rounded extremity of the pectoral fin, the concealed inner angle of which is also rounded.

Fig. 2. Dorsal view of peduncle, showing the pronounced keel, 2d dorsal fin, superior caudal pit, crimped anterior border of supracaudal lobe, and part of the infracaudal.

Fig 3. Ventral view of head to show conformation of snout and relations of nostril, eye, mouth, and 1st gill-cleft.

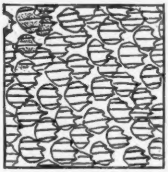


Fig. 1. Denticles of *Isurus tigris* on 1 square mm. of the back near 1st dorsal. Enlarged 25 diameters.

Fig. 2. The first 4 teeth from middle of jaws. The diminutive 3d tooth in the upper jaw is a character of the species. Reduced.

The New York specimen (Brooklyn Museum, No. 567 ♀), was of a dark, clear blue color above, and white below, the demarcation being sharply defined, as described by Garman. Upper surfaces of pelvic fins partly white and partly dark blue; blue of the gill-flaps lighter, almost silvery. Length of head to first gill-cleft (not the "fifth," as erroneously printed in Garman's monograph), nearly one-fourth of total length. Teeth in $\frac{26}{26}$ rows. Fifth gill-cleft hooked around anterior insertion of pectoral fin. Antero-dorsal border of supracaudal lobe "crimped" or laterally undulated throughout its length (Plate I, fig. 2). Supracaudal one-fourth longer than infracaudal. Posterior margin of supracaudal terminating in an accessory lobe about one-fourth the length of the fin and having an attenuated, frayed edge. In other respects the specimen agreed with Garman's description.

Measurements in Centimeters.

Tip of snout to—	
center of caudal fin (total length)	144.0
anterior margin of eye	11.8
lower end of nostril	8.0
angle of mouth	21.8
center of upper jaw	11.0
anterior base of pectoral	44.0
anterior base of dorsal	61.0
lower end of 1st gill-cleft	36.0

Length of 1st gill-cleft	12.0
Antero-posterior diameter of eye	2.9
Distance across head between eyes	10.2
Length of anterior border of pectoral	28.0
Height of dorsal	15.7
Anterior base of dorsal to anterior base of 2d dorsal	55.0
Anterior base of 2d dorsal to base of supracaudal	17.0
Length of supracaudal from dorsal pit	36.0
Length of infracaudal from ventral pit	27.0
Chord of caudal fin (tip to tip)	45.5
Greatest width of keeled peduncle	14.0

A portion of this shark's skin was tanned by the Ocean Leather Company, of New York, and it produced a high-grade, tough, pliable leather, capable of taking a pronounced gloss.

THE LARGE SHARKS OF CAPE LOOKOUT, NORTH CAROLINA. THE WHITE SHARK OR MANEATER, TIGER SHARK AND HAMMERHEAD.

Russell J. Coles, Danville, Va.

Plates 2 and 3.

In May, June and July, 1918, at Cape Lookout, North Carolina, I handled large numbers of sharks of many kinds for leather, food, oil and fertilizer, having established a shark-fishing station at that point now controlled by the Ocean Leather Company of New York, with which I am associated. The work was so intensive that it was impossible to make the scientific study of the material that I would have wished. It is perhaps true that sharks are well known in inverse ratio to their size, and my observations on those three species which attain the greatest dimensions are of greatest scientific interest.

Such notes as I was able to make I submitted to the Department of Ichthyology of The American Museum of Natural History, where Mr. John T. Nichols has given material aid in selection and arrangement of the matter contained in this article.

Carcharodon carcharias. White Shark. "Man-eater."

This species is so rare along the Atlantic Coast that when I captured a young specimen 6 ft. 2 in. in total length at Cape Lookout in May, I at once made careful measurements of it. It was a male but the claspers were only 1½ in. long. Shortly thereafter, about May 20th, I took a young female of the same species, and made measurements also of this specimen.

	Male	*Female*
Tip of nose to tip of tail	6 ft. 2 in.	7 ft. 3 in.
Tip of nose to origin of 1st dorsal	2 ft. 3 in.	2 ft. 10 in.
Origin 1st dorsal to origin 2d dorsal	1 ft. 11 in.	2 ft. 3 in.
Height 1st dorsal	7 in.	9 in.
Height 2d dorsal	1½ in.	1½ in.
Width 1st dorsal	8 in.	11 in.
Width 2d dorsal	1 in.	3 in.
Width of peduncle with keel	6 in.	7½ in.
Depth of peduncle	2 in.	2¼ in.
Width between upper and lower tail tips	1 ft. 8 in.	2 ft. 1 in.
Upper fork of tail, notch to tip	1 ft. 5 in.	1 ft. 1 in.
Lower fork of tail, notch to tip	1 ft. 2 in.	1 ft.
Length of pectoral	1 ft. 3 in.	1 ft. 5 in.
Width of pectoral	8½ in.	9½ in.
Girth	3 ft. 10 in.	4 ft. 3 in.
Tip of nose to mouth		6 in.
Tip of nose to eye		6 in.
Tip of nose to angle jaw		11 in.

Further notes on the female follow. Eye, large and dark in color. Belly clear white. Upper parts very dark blue-gray. A black spot on the upper surface of the pectoral with its front angle at the center of the base of the fin, outer angle extending towards the center of the fin, including the posterior lobe at the base of the fin and also extending onto the body. In color the flesh was distinct rich light pink salmon (I have never seen the flesh of any other shark so colored), except that extending along in the pink flesh on each side of the vertebral column from skull to just above vent there was an almost round strip of nearly black flesh. Both pink and black flesh were eaten and proved excellent. Usually the flesh of sharks is almost free of oil, but that of this fish was rich in oil, and its liver richest in oil of any that I

have seen. It was the very finest shark, or, in fact, fish of any kind that I have ever eaten, its flavor being quite similar to a big, fat white shad. I made an entire meal of man-eater shark, eating nearly two pounds for dinner.

A day later, the morning catch of 14 sharks included two more young man-eaters, both females, one 7 ft. 7 in. long, and one 7 ft. 3 in. long, and I made all measurements and observations to check and confirm absolutely my notes regarding the one taken on the previous day.

At the very time when the second young man-eater was captured, fishermen claim to have seen a very large shark, with similar lamnoid tail, as long as their 25-ft. launch, entangled in a nearby net. It fought very violently and they cut it loose. I did not give their report entire credence, allowing for possible exaggeration, until on June 28th I found a large white shark in a dying condition in one of the nets, which may well have been the same individual. Unfortunately it escaped in its death-struggle.

My carefully noted observations justify the following claim of dimensions for it: length, 22 ft.; head, larger than 50-gallon barrel; mouth, 3 ft. wide; circumference at arm-pit of pectoral, 18 ft.; length of pectoral, 6 ft.; width of pectoral, 3½ ft.; dorsal, not seen; width at caudal notch, origin of tail, 20 in.; width of tail, 7 ft.; weight, over 2 tons.

I consider it highly probable that this large shark was the mother of the young ones taken, and that she had given birth to them near Cape Lookout in May. These are points which make the presence of this species here still more interesting.

The white shark is a more general feeder than the hammerhead, but subsists largely upon fishes of its own catch, and in four small examples, which I have recently examined, the only recognizable material contained in their stomachs was *Cynocion regalis* (weakfish), and *Menticirrhus americanus* (whiting). As they reach greater age they show a disposition to

specialize on other food, which is often sea turtles. In my opinion few white sharks ever attack man or look on him as food, but a white shark having once done so, by chance, that individual immediately becomes very dangerous.

I hope I will be pardoned for introducing into a scientific paper of this nature my first two adventures with the white shark. In 1903, in the Bight of Cape Lookout, North Carolina, I was out in a very small skiff harpooning turtles, and armed with rifle, light harpoon, and heavy knife, when an 18-ft. shark, easily recognizable as this species, charged, halting only when in contact with my skiff, where, with its large staring eye watching my every move, it lay for some seconds almost motionless with part of its back exposed above the surface, while I crouched with finger on the trigger of the high-powered rifle, aimed in front of the first dorsal fin. The shark then began a series of rapid evolutions, turning several times on its back while circling the skiff, into which it splashed much water. It then retired to a distance approximating a hundred yards and then, turning, charged at great speed directly at the skiff, when suddenly in the line of its attack a large logger-head turtle came to the surface and was seized in the jaws of the shark, which I heard crushing through the shell of the turtle. I am convinced that this shark had satisfied himself that I was suitable for food and had only retired to acquire speed for leaping into the skiff and seizing me, and that the coming to the surface of the turtle at that instant was all that saved me from a dangerous, knife to shagreen fight.

My second adventure with the white shark occurred some years later, and although it contained an instant of close infighting, yet it was much less dangerous, for I was then trained and steadied by having won many knife fights with sharks and large rays. After trying for an hour to approach within harpooning distance of a large man-eater which was swimming in shallow water near the scene of my former

encounter, I got over-board in a depth of five feet of water and had the boat retire to a distance of a hundred yards with the coil of rope, which was attached to the harpoon which I had with me. I also took with me half a bushel of crushed and broken fish to attract the shark, which was then swimming on or near the surface, half a mile to leeward of me. Soon the shark could be seen zig-zagging its course toward me, by crossing and re-crossing the line of scent from the broken fish, just as the bird-dog follows up the scent of quail. With harpoon poised, I crouched low, trusting that its approach would be continued in this manner, until, by a long cast, I could fasten my harpoon in its side. The scent of the broken fish, however, was so strong that they were definitely located, and the shark charged from a hundred feet away with a speed which has to be seen to be appreciated. I met the onrushing shark by hurling my harpoon clear to the socket into it, near the angle of the jaw, and, as the iron entered its flesh, the shark leaped forward, catching me in the angle formed by its head and the harpoon handle, which caught me just under the right arm, bruising me badly, while my face and neck were somewhat lacerated by coming in contact with the rough hide of the side of its head. As my right arm was free, it was a great chance for using the heavy knife, with which I was armed, had my tackle been strong; but the force of the blow snapped the poorly-made harpoon at the socket and the shark escaped, although it carried its death wound. I never again employed the same black-smith to forge my harpoons, but that poorly-made iron surely brought to a sudden ending a most exciting situation.

Galeocerdo tigrinus. Tiger Shark.

This is an abundant and widely distributed shark, very easily identified by its big head and tapering body, spotted color, and unique teeth. It is doubtless due to its large size and the consequent difficulty

of handling specimens that it seems to be imperfectly described in current literature. In the figure in Nichols and Murphy, Long Island Sharks,[1] for instance, I find the dorsal fin placed too far forward, and the long peduncular keel, which is a characteristic feature of the species, has been quite generally overlooked. It is with much pleasure, therefore, that I publish a photograph which shows the characters of the fish very well, and also the measurements of two female specimens, one of 6 feet, taken May 27th, and one of 12½ feet, taken July 5th.

	Young	*Adult*
Tip of nose to tip of tail	6 ft.	12 ft. 6 in.
Across top of head from eye to eye	9 in.	1 ft. 9 in.
Tip of nose to origin 1st dorsal	1 ft. 8 in.	4 ft.
Origin 1st dorsal to origin 2d dorsal	1 ft. 10 in.	2 ft. 10 in.
Caudal notch to tip of tail	1 ft. 9 in.	2 ft. 9 in.
Caudal notch to bottom tip of tail		1 ft. 8 in.
Fork notch of tail to top tip of tail	1 ft. 5 in.	
Fork notch of tail to bottom tip of tail	5 in.	
Width at caudal notch	3½ in.	
Depth at caudal notch	2½ in.	
Side mackerel-like keel extending up the sides faintly as far as origin 2d dorsal		
Length pectoral	9½ in.	1 ft. 10 in.
Width pectoral	6 in.	1 ft. 4 in.
Width 1st dorsal	8½ in.	1 ft. 3 in.
1st dorsal, height	6½ in.	1 ft. 10 in.
2d dorsal, width	5½ in.	10 in.
2d dorsal, height	2 in.	5 in.
Girth (at origin 1st dorsal)	2 ft. 1 in.	5 ft. 8 in.

Further notes concerning the young shark follow. Eye, large, dark, staring, and near tip of nose. Blunt, wide head. Mouth wide and near tip of snout. Color white on belly, but dark on back and sides, with darker vertical tiger-like markings. Specimen very thin, with empty stomach. My personal test proved the flesh excellent for food.

Further notes concerning the adult shark follow. Side keels extending from caudal to gill slits, more pronounced near tail. Vertical stripes or tiger markings not so plainly marked as in young. Color of back very dark, belly white. Stomach con-

[1] Nichols, J. T., and Murphy, R. C., 1916. Long Island Fauna—IV, The Sharks, Brooklyn Museum Science Bull., Vol. 3, No. 1.

tained most varied assortment of food that I have ever found in any shark, consisting of parts of three very large stone crabs, one bird, the small diver called locally water witch, and other unidentified substances. Its liver was 7 ft. in length, and rich in oil, (actual yield, 15 gallons). Eye, the usual dark, staring eye of the man-eating sharks. I weigh 275 lbs. and have a 52 inch waist, yet I passed through its jaws, which I have nicely cleaned. This shark was not securely fastened in the net and was tearing its way out when I fastened it with a harpoon just in time, and a most savage fight followed. The parts of the tail stood more at an angle with the body than in the young, but the angle was not as pronounced as in the great white shark.

There can be little doubt that the tiger shark regularly preys on other sharks to a considerable extent. During the few weeks that I was watching the fishery at Cape Lookout I examined the stomachs of three young tiger sharks, and in all three I found cleanly bitten pieces of freshly eaten shark-meat with skin attached, just as if the chunk of meat had been cut from the side of a shark. In the largest example, 7 ft. 9 in. in length, caught in my nets June 25th, there were eleven of these chunks of shark meat of from 1 to 5 lbs. each in weight, and they represented *hammerhead, sharp-nosed* and *ground sharks.*

Additional observations made during first week of August on three more tiger sharks, each in excess of twelve feet in length, confirm my former observations as to the varied character of their food. In one of them I found a freshly-eaten logger-head turtle, approximating 100 lbs. in weight, which had been bitten through both shells, in three places and the pieces of shell much crushed, yet all parts of the turtle were present.

Probably tiger sharks will use as food, when hungry, any creature which they find moving in the water, for which reason they must be dangerous as maneaters; but I do not regard them as nearly so danger-

ous as a white shark which has once acquired the habit of eating human flesh. While it is not fastidious, I have no evidence as yet that even the tiger shark will eat unclean food, and in my opinion, the sharks which eat garbage or putrid matter are exceptional individuals, which, through some accident, have acquired the habit.

Sphyrna zygaena. Hammerhead Shark.

One of the most interesting facts about the hammerhead shark is that some of the large females with non-functional uteri are abnormal in form and feeding habits. Below are presented detailed measurements of a normal large female for comparison with such an abnormal shark.

The former, 11 ft. 1 in. in total length (snout to tip of caudal), enmeshed in a net and dead when taken out, July 10th, had apparently been feeding exclusively on Spanish mackerel, as this was the only recognizable material in its stomach. I consider fish like the Spanish mackerel the normal food of the hammerhead shark.

The second, 13 ft. 10 in. long, was captured a week earlier. It is probable that within the previous two weeks this large shark had eaten from my nets more than 50 sharks of about 6 ft. in length, leaving only their heads gilled in the net; and, with at least half a dozen species to select from, it was always her own species which she selected. At the time of her capture she had just eaten four of her species from my net, two of which had been swallowed whole, except the head of 5 ft. examples, and there were four cleanly-cut pieces which represented entire bodies, except heads, of two more 6 ft. hammerhead sharks; then the stomach contained more than a peck of vertebrae of sharks, provisionally identified as her own species.

There is probably no fish as careful about its diet as the shark, and those that eat anything but freshly caught fish are the exception and not the rule.

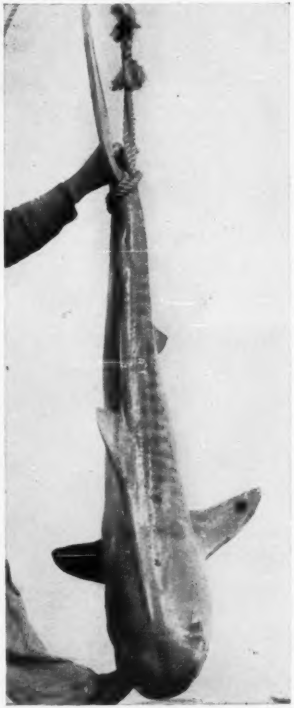
Some species even subsist almost exclusively upon only one species of fish, to such an extent that when a person is fishing for them with a hook baited with a perfectly good fresh fish, he may see a shark nose the baited hook repeatedly and leave it. I have had certain sharks repeatedly reject in this manner several species of fish and then eagerly take the hook when baited with the species of fish which is their habitual food. This is especially true of the hammerhead shark, which follows and subsists on the schools of Spanish mackerel, and of the very many which I have examined the stomachs of all but a small fraction contained, as far as I have identified, no other substance than Spanish mackerel. The exceptions were only very old examples, several of which had become solitary in habit and subsisted exclusively upon sting rays, which, as far as observed, were ***Dasyatis***. Others, which were easily recognizable by their badly worn teeth, had become cannibalistic and confined their cannibalism to their own species.

I attribute this abnormal condition to great age. I have examined specimens over 14 ft. long, in every way normal and with functional uteri, which I do not consider so old.

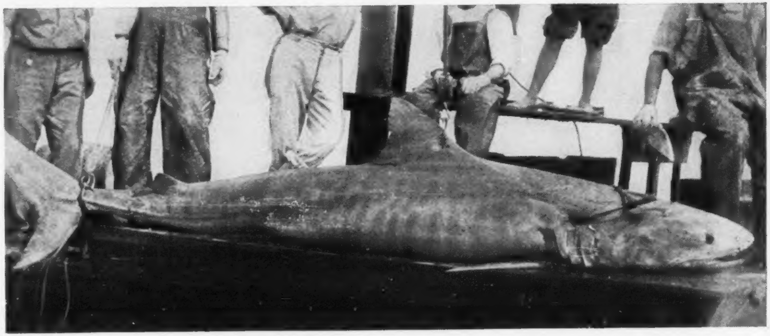
I believe that certain examples of hammerhead shark of great age become cannibalistic, by evidence afforded by a number of examples, but I have no evidence that such is the case before their length exceeds 10 ft., and I have probably examined a thousand examples.

The present specimen of 13 ft. 10 in. illustrates the change of form accompanying this change of habit. This example is abnormal in point of stoutness, for, to have been normal with this circumference, length of fins and very great weight, the width of head should have exceeded 5 ft. and the length of body should have exceeded 16 ft. The mouth and teeth were also abnormally large for this short length.

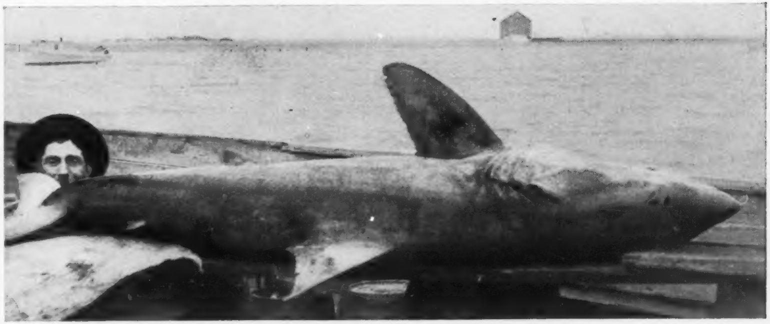
The uteri of this specimen were small, malformed, almost obsolete, and non-functional. From



1.

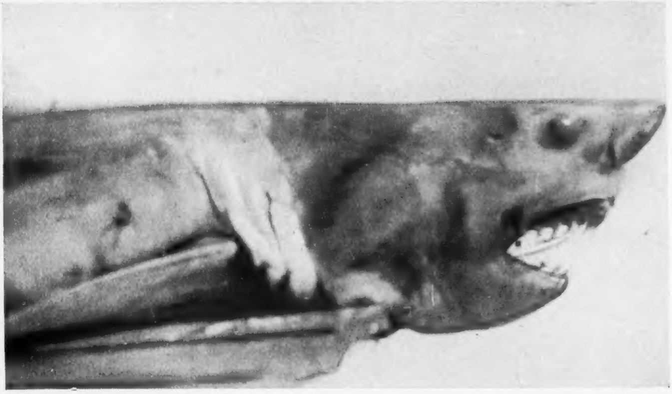


2.



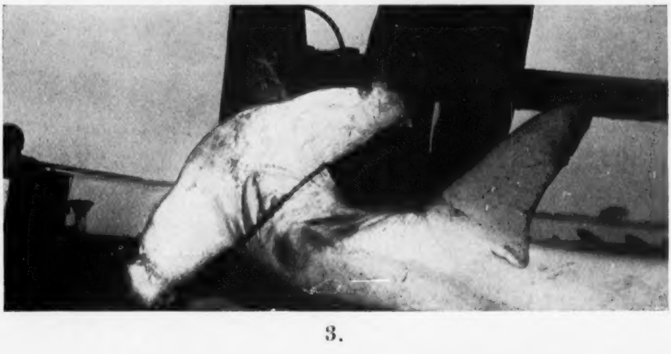
3.

Fig. 1. *Galeocerdo tigrinus*, young. Fig. 2. *Galeocerdo tigrinus*, adult. Fig. 3. *Carcharodon carcharias*, young.



1.

2.



3.

Fig. 1. ***Carcharodon carcharias*, young. Fig. 2. *Sphyrna zygaena*, adult ♀, abnormal.**
Fig. 3. *Sphyrna zygaena*, adult ♀, normal.

evidence obtained by examination of the uteri of many very old female sharks, I am of the opinion that after they have reached very advanced age, their reproductive organs cease to be functional.

Hammerhead	No. 1 (Normal)	No. 2 (Abnormal)
Length	11 ft. 1 in.	13 ft. 10 in.
Tip of nose to origin 1st dorsal	3 ft. 2 in.	4 ft. 2 in.
Origin 1st dorsal to origin 2d dorsal	3 ft.	4 ft. 2 in.
Height of 1st dorsal	1 ft. 7 in.	2 ft. 7 in.
Width of 1st dorsal	1 ft. 5 in.	1 ft. 9 in.
Height of 2d dorsal		11 in.
Width of 2d dorsal		1 ft. 3 in.
Caudal notch to tip of tail	3 ft. 10 in.	
Length of pectoral	1 ft. 6 in.	2 ft.
Width of pectoral	11 in.	1 ft. 4 in.
Width of head,—eye to eye	2 ft. 8 in.	3 ft. 6 in.
Length of head,—side of neck to tip of nose	10 in.	
Width of head at spiracles		9 in.
Head, notch at tip of nose to mouth		8½ in.
Narrowest point of length near eye	6 in.	
Tip of nose to front of mouth	6½ in.	
Top fork of tail, from notch to tip		3 ft. 9 in.
Bottom fork of tail, from notch to tip		1 ft. 1 in.
Circumference at origin 1st dorsal	4 ft.	5 ft. 7 in.
" at neck	2 ft. 8 in.	4 ft. 1 in.
" at vent	2 ft. 8 in.	
" at caudal notch	1 ft. 4 in.	1 ft. 8 in.
" at base 2d dorsal		2 ft. 11 in.
Length of head from side of neck to front		10½ in.

I may further note in regard to the first of these two sharks that the front of its head was more crescentic in form than usual in the species, the notch in the center of the nose only faintly indicated, and that it contained at least 18 young, almost ready to be born. The smallest was 1 ft. 9¾ in. long, head 5¾ in. wide, the largest 2 ft. 2½ in. long, head 7 in. wide, average length 2 ft., width of head 6¼ in. Size of young in sharks depends on size of mother. I have often caught sharks of this species, long after their birth, measuring less than 20 inches, indicating a smaller mother, and I have found larger embryos not so far advanced in a larger example.